Description

MECHANICAL SYSTEM FOR POWER CHANGE BETWEEN THE INPUT AND OUTPUT THEREOF

Technical Field

This invention relates generally to a system for supplying power at an output in response to an input source thereof, and more particularly concerns such a system which produces a power change between the input and outputs thereof.

Background of the Invention

The generation of power, and correspondingly, machines which use power to produce work, such as by the turning of a shaft by electric power, are quite important to modern industry and society. Electric power is used to run a large number of machines which vary substantially in output capability, depending upon the task, from less than one horsepower to several thousand horsepower and even greater, to accomplish specific tasks. Electric power is also used to power electric lights and many electric appliances.

The sources of electric power also vary widely, including large electric power generating plants using, for instance, hydroelectric capability, fossil and/or nuclear fuels, among others. Electric power produced by such plants is then supplied to individual users, through large, complex and expensive transmission and distribution systems. Power is lost in the transmission and distribution system. Alternatively, small, stand-alone electric power sources such as electric generators or micro turbines, which are typically run by fossil fuel (gasoline) engines, natural gas turbines or other similar devices, are capable of supplying small amounts of power for specific users. These generators are also not 100% efficient.

Electric motors are also less than 100% efficient, as are systems using electric power directly, such as lighting systems. Some energy is lost in carrying out specific work, *i.e.* turning a shaft or lighting a filament in a bulb, for instance. Efficiencies of modern electric motors can be quite

high, however, exceeding 90%. It is desirable that electric motors or similar devices have efficiencies as high as possible, and further, it is desirable to produce electric power using as little energy as possible. Historically, it has been a goal to actually be able to increase electric power from input to output, although this has not been heretofore realized.

Furthermore, it is highly desirable to have a capacity of local sources of electric power, particularly inexpensive power, independent of existing power distribution systems, without the requirement of large supplies of fuel, such as fossil fuel in particular. One example is for powering irrigation systems in, for instance, third world countries, where the cost of energy to run such systems adds significantly to the cost of food production. Economic electric-powered vehicles are also desirable and are another example where system improvements would be advantageous to the environment.

Summary of the Invention

Accordingly, the present invention includes at least two power disc elements mounted for rotation about a central axis, wherein the first power disc element includes a first peripheral portion in the vicinity of the rim thereof by which the first power disc element is turned; a first system gear, mounted on a first system shaft which is offset from the central axis; wherein the first power disc element has a second peripheral gear portion in the vicinity of a forwardly extending rim portion of the power element, and wherein the second power disc element has a plurality of outer drive gear members rotatably mounted to a rear surface thereof and positioned so as to mate with the second peripheral gear portion on the first power element; a central gear which is mounted so as to be fixed relative to the central axis and which is further mounted to mate with the outer drive gears on the second power disc element, such that rotation of the first system gear by a motor results in rotation of the first and second power disc members; and a second system gear mating with a peripheral gear portion of the second power disc element, located in the vicinity of the

rim of the second power disc element, the second system gear mounted on a second system shaft which is offset from the central axis, wherein in operation a power change results between first and second system shafts.

Brief Description of the Drawings

Figure 1 is an exploded view of the power system of the present invention.

Figure 2 is a side elevational view of the system of the present invention.

Figure 3 is an exploded view of a portion of the system of the present invention.

Figure 4 is an exploded view of another portion of the system of the present invention.

Figure 5 is an exploded view of another portion of the system of the present invention.

Figure 6 is a diagram of an application of the system of the present invention involving a vehicle.

Best Mode for Carrying Out the Invention

The system of the present invention, shown generally in one embodiment at 10 in Figure 1, produces an efficient power change between the input and output ends of the system. The system, generally shown at 10, is driven by a conventional electric motor 12 at one end of the system 10 in Figure 1. In the embodiment shown, electric motor 12 is relatively small, *i.e.* a two horsepower, single-phase motor, operating at 110 volts. However, it should be understood that the input motor could be significantly larger and/or could be a three-phase motor operating at 220 volts. The characteristics of the drive motor are not critical to the present invention.

Electric motor 12 includes a conventional output shaft 14, also referred to herein as a system input power shaft, which extends through a first fixed support bracket 16. Support bracket 16 supports the present power system at one end thereof and extends upwardly from a base support member 18 (Figure 2). At the other end of the system 10 is a second support bracket

20. The support arrangement (elements 16, 18 and 20 in the present system) can vary widely in configuration and structure, depending upon the particular arrangement of the power system 10 itself.

Referring now to Figures 1-5, mounted on the free end of system input power shaft 14 of electric motor 12 is an input drive gear 24. In the embodiment shown, input drive gear 24 drives an input power disc 26. The input power disc 26 in the embodiment shown is circular, approximately 18 inches in diameter, and includes a central portion 28 with a central axial opening 30 and a rim portion 32 which extends perpendicularly from central portion 28 both from a rear surface 33 of central portion 28 and an opposing forward surface 35 of the central portion. In the embodiment shown, the rim portion in both rear and forward directions is approximately 2-1/2 inches wide, with first and second sets of gear teeth 34, 36 on the inner surfaces of rear section 37 and the forward section 39 of the rim portion 32.

The input drive gear 24 in the embodiment shown is 6 inches in diameter, has 66 teeth and is positioned to mate with gear teeth set 34 on the rear section 37 of rim portion 32 of the input power disc 26, because the output shaft 14 of the motor 12 is offset from the center of the input power disc 26.

The input power disc 26 is mounted for rotation on a main shaft 38, which is also supported at opposing ends thereof by supporting brackets 16 and 20. Power disc 26 is mounted by a key 39 on shaft 38 to a bearing 40 which is positioned in axial center opening 30 in the central portion of the power disc. The keying of the central shaft to bearing 40 is not critical but does reduce possible wear due to undesired rotation of the bearing. Bearing 40 in this embodiment does not rotate, but permits input power disc 26 to rotate freely on the bearing relative to the main shaft. As discussed below in more detail, in some arrangements, main shaft 38 can rotate to some extent to achieve particular system results.

In operation, shaft 14 from motor 12 will rotate the input drive gear 24, which will rotate the input power disc 26

about main shaft 38, in particular bearing 40. The speed of rotation of the input power disc 26 depends upon the rotation of shaft 14 and the relative size ratio between input drive gear 24 and power disc 26 (with the gear set 34 on input power disc 26 being at its rim). For instance, if the power shaft 14 rotates at 1786 rpm (the rating of motor 12), when input drive gear 24 is 6 inches in diameter and power disc 26 is 18 inches in diameter (3:1 ratio), the first power disc will rotate at 595-1/3 rpm.

A first intermediate power disc 42 follows input power disc 26, and is also mounted on main shaft 38 through bearing 43, which is keyed to main shaft 38. The first intermediate power disc 42 has a flat rear surface 44 and a rim portion 46 which extends in the forward direction. Rim portion 46 is identical to the forward section 39 of rim portion 32 on input power disc 26. The first intermediate power disc 42 is otherwise substantially identical to input power disc 26, having the same diameter, configuration and structure thereof, and mounted for rotation on main shaft 38 through bearing 43.

Rotatably mounted to rear surface 44 of first intermediate power disc 42 are three equally spaced outer drive gears 50, 52 and 54. Each of the outer drive gears 50, 52 and 54 are also 6 inches in diameter and have 66 teeth around the periphery thereof, in the embodiment shown. The gears 50, 52 and 54 are mounted for rotation by bolts 60-60 and bearings 62-62. The outer drive gears 50, 52 and 54 are free to rotate in operation about their individual associated bearings 62-62 on bolts 60-60. As a possible alternative structure, there could be two or even just one outer drive gear. Speed of operation may be limited, particularly with just one gear, and the mounting structure might have to be modified to some extent. Mounted at the center of rear surface 44 between, and meshing with, outer drive gears 50, 52 and 54 is a central gear 64, which in the embodiment shown is substantially identical to outer drive gears 50, 52, 54.

Central gear 64 is in the same plane as outer gears 50, 52 and 54. Central gear 64 is keyed to main shaft 38, as

are power discs 26 and 42; hence, if main shaft 38 does not rotate, neither does central gear 64, while if main shaft 38 in a particular arrangement does rotate a selected amount, central gear 64 will move therewith. Additional washers, spacers and/or shims may be added to the system, such as for alignment or wear purposes, but are not critical to the invention.

In the embodiment shown, input power disc 26 and the first intermediate disc 42 are made from steel. The central portion of the input power disc is approximately 1-1/2 inches thick, while the central portion of the intermediate power disc is approximately 2 inches thick. The rim portion of input power disc 26 is approximately 2-1/2 inches thick, while the rim portion of intermediate power disc 42 is also approximately 2-1/2 inches thick. It should be understood, however, that the power discs can be made in different sizes, with different materials, including aluminum and even various plastics, which will change the overall weight of the system. Further, while there are three outer drive gears shown, in some configurations there could be two outer drive gears, or in some cases, more than three. In addition, while the outer drive gears are shown to be the same size as the central drive gear in the embodiment shown, it is possible that the central drive gear could be a different size from the outer drive gears. Also, while the input drive gear is one-third the size of the input power disc, in the embodiment shown, a different ratio could be used.

The first intermediate power disc 42 is positioned on shaft 38 relative to the input power disc 26 such that the forward edge 45 of rim portion 32 of input power disc 26 is spaced slightly apart from rear surface 44 of the first intermediate power disc, permitting free rotation thereof, but further such that outer drive gears 50, 52, and 54 on intermediate power disc 42 mesh with gear set 36 on the forward section 39 of rim portion 34 of input power disc 26.

In operation, the rotation of input power disc 26 caused by the driving action of input gear 24 will result in rotation of the outer drive gears 50, 52 and 54 about their associated mounting bolts, and through mechanical interaction

with central gear 64 will initiate rotation of the first intermediate power disc 42. The first intermediate power disc 42, the three outer drive gears 50, 52 and 54, and associated mounting bolts and bearings and the central gear 64 keyed to main shaft 38 form a first intermediate power disc assembly.

Successive power disc assemblies, identical to the first power disc assembly in this embodiment, are positioned successively along main shaft 38, with each intermediate power disc assembly interacting with the next successive power disc assembly by the mating of the gear set on the forward rim section of one intermediate power disc with the three outer drive gears in the next successive intermediate power disc assembly. Thus, in the arrangement shown, the rotation of each intermediate power disc will produce rotation of the next intermediate power disc, with the rotation (rpm) speed of each intermediate power disc being approximately one-third lower than that of the previous power disc.

In the embodiment shown in Figure 1, there are four intermediate power disc assemblies. Following the last intermediate power disc assembly in the system of the present invention is an output power disc 70, which is basically identical to the power disc in the several intermediate power disc assemblies. An output or takeoff gear 74 is mounted on a power shaft 76 of another electrical device, such as for instance a generator 78, positioned at the output end of system 10. Generator 78 can produce electricity. Power shaft 76 is offset from the main drive shaft 38 upon which the individual power discs are rotatably mounted, similarly to the offset of the system input power shaft 14 of motor 12 relative to the main shaft 38. The output gear 74 is in the embodiment shown substantially identical to the input gear 24 in configuration, size and the number of teeth, and is positioned to mate with the gear set on the internal surface of the rim of the power disc 70. A 3:1 ratio thus exists between output power disc 70 and output gear 74, such that output gear 74 has an rpm of three times that of the power disc 70.

In operation, electric motor 12 will drive the system of the present invention at steady-state following a relatively short start-up, during which all of the power discs are brought up successively to steady-state speed. Output/takeoff gear 74 will rotate power shaft 76, driving generator 78 to produce an electric power output.

It should be understood that the arrangement of Figure 1 is only one embodiment. For instance, in the arrangement of Figure 1, the input electric motor 12 located at one end of the system results in an output shaft rpm which is less than that of the rpm of the motor, assuming that the input and output gears are the same size, *i.e.* each successive power disc from the electric motor end to the generator end of the system turns at a decreased speed (1/3 less) than the previous power disc. The motor and the generator, however, could be reversed, such that the speed of the output shaft is greater than the speed of the input electric motor shaft, with an approximately 1/3 increase in speed for each successive power disc assembly in the system. The system of the present invention can be operated advantageously in both directions. In such a case, the output/takeoff gear would be the input gear, driven by the motor, and the input gear would be the takeoff gear, driving a generator or similar device.

Further, while the input gear and the output/takeoff gears mate, respectively, with gear sets on an internal surface of the rims of the input and output power discs, it should be understood that the input drive gear and the output takeoff gear can mate with a gear set on an exterior surface of the rim portion. Hence, gear sets on the internal surfaces of the rim portions of the input and output power discs are not essential to the invention. Other arrangements could be used for providing input power to the system of taking power from the system, including a sprocket drive gear or other means, including belts or fluids or magnetic systems.

Still further, while the arrangement shows a total of four intermediate gear assemblies, a greater or lesser number can be used, depending upon the amount of power change/advantage

desired. At a minimum, however, there must be an input power disc assembly and an output power disc assembly providing a first level of power change/advantage. In such a minimal arrangement, the four intermediate discs shown in Figure 1 would be eliminated, with the output power disc assembly mating directly with the input power disc assembly. There also could be arrangements where there are more than four intermediate power discs, with each additional power disc assembly being identical to the power disc assembly shown, with the total number of disc assemblies being dependent upon the degree of power/change advantage between the input and output desired.

A number of factors influence the operation and the amount of power change/advantage of the above system. For instance, the relative size difference between the outer drive gears, the size of the power disc to which they are rotatably mounted, and the size of the central drive gear all affect the power change/advantage and/or the speed increase/decrease of the rotation of the successive power discs in the system.

As indicated above, the central shaft in the embodiments shown typically remains fixed, so that the central gear does not rotate in operation of the system. The rotational arrangement and interaction of the outer drive gears and the central gear on the one surface of the power disc results in a force/pressure on the mounting bolts holding the outer drive gears, such that the power disc on which the outer drive gears are mounted begins to rotate in response to rotation of the previous power disc and the mating of its rim gear with the outer drive gears. The mounting shaft can, however, be allowed to rotate to some extent in one direction at startup. The overall power change/advantage of the system would be decreased, depending upon the amount of rotation of the mounting shaft, but startup of the system would be more efficient and take less time.

Further, the mounting shaft and the central gear thereon could be made to rotate slightly in the opposite direction from the power discs, which would increase the power gain from one stage to the other. Typically, there must be a

substantial difference between the rotational speed of the outer drive gears and the central gear.

Also, the embodiment shown has a gear ratio of 3:1 between the initial drive gear and the input power disc and a 1:3 ratio between the output power disc and the output/takeoff gear. While these ratios can be varied, change will affect the power advantage. Further, in some cases there may be an additional gear or gears at the output to increase the speed of the output shaft. Since traditional gear system ratios affect power output when they are a part of the input or output of the system, consideration must be given to the specific power requirements of each application. A gear ratio which is too high, for instance 10 times, may negatively affect the power efficiency/advantage of the system.

Hence, a mechanical system has been disclosed which provides a high power efficiency or power advantage from the input end to the output end thereof. The system can be arranged such that the output speed of the system is higher or lower than the input speed (*i.e.* the motor speed). Further, as shown above, various arrangements can be utilized to produce specific desired results.

Figure 6 shows a vehicle application for the system of the present invention. The vehicle 200 includes a conventional AC electric motor 202, which is run by a vehicle battery 204 through an inverter 206 which is part of the vehicle control system, which produces the required AC voltage to run motor 202 from a DC voltage provided by the battery. The output of motor 202 is applied to a system of the present invention, shown generally at 208, which results in a power advantage, the output of which is applied to a conventional generator 210. One output from generator 210 is applied to a charger 212 in the control system, which charges the vehicle battery 204, which in turn then continues to run the engine 202. This circuit provides the electric power for the vehicle.

The other output from generator 210 is directed to a second electric motor 214, the output of which is applied as a drive to a second power system of the present system 216. Power

system 216 provides another power advantage used to drive the vehicle in standard use by transmission 218. The system of Figure 6 can be a self-sustaining vehicle system, requiring minimal if any additional power, due to the use of the two onboard power systems of the present invention 208 and 216. In case battery 204 needs an additional power recharge on occasion, conventional sources of electric power can be used for such recharging. However, even if such recharging is necessary from time to time, the vehicle of Figure 10 using the present invention is still extremely efficient, relative to the electric power use from the conventional power grid required by a conventional electric car.

The control system can manage the power generated by the generator 210 and direct it as needed to the charging system for the battery 204 or the second electric motor 214. Since the power system 208 will typically be operated at full speed, power could be directed to charging the battery when the vehicle is stopped. The size and scale of the components could be optimized for various uses and vehicles.

It should also be understood that various intermediate gears can be incorporated between each power disc assembly in order to change gear ratios, speed or size of the next power disc. Also, while the power discs shown herein are round, the discs may have shapes other than round.

Although a preferred embodiment has been disclosed for purposes of illustration, it should be understood that various changes and modifications and substitutions could be made in the preferred embodiment without departing from the spirit of the invention as defined by the claims which follow:

What is claimed is: